

PAPERS.

31. On Three New Trematodes from Reptiles.

By WILLIAM NICOLL, M.A., D.Sc., M.B., F.Z.S.*

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(Plates XXVII. & XXVIII.†)

The following notes were made on a collection handed over to me by the Prosector of the Zoological Society. In no case was the habitat noted, but from their affinities it may be presumed that the specimens all came from the lungs, the mouth, or the cesophagus. The specimens are interesting as forming an important addition to our knowledge of the large variety of forms which inhabit the air-passages and anterior end of the alimentary canal of reptiles and batrachians. To the taxonomy of this particular group Odhner has recently (1910) made a valuable contribution, which will be further referred to later.

The first species is from the Hog-nosed Snake (*Heterodon platyrhinus*), and I include it provisionally in the genus *Lechriorchis* Stafford, 1904. Like most of Stafford's genera, this genus is insufficiently defined, although the fact that he includes in it the well-described species *L. (Renifer) elongatus* Pratt, 1903, is something to go upon. It is, therefore, necessary to amend Stafford's definition somewhat, as follows.

Genus LECHRIORCHIS Stafford, 1904.

Resembling *Renifer* Pratt, 1903, except in the following particulars. The intestinal diverticula extend a short distance beyond the testes; the genital aperture is further from the edge of the body, midway between it and the pharynx; there is a well-developed vagina.

These constitute, as far as appears, the only differences between the two genera.

LECHRIORCHIS VALIDUS, sp. n. (Plate XXVII. figs. 1-5.)

This is a species of moderate size, measuring 3.6-7.4 mm. in length by .9-1.4 mm. in breadth. The smallest specimens had just begun to produce ova, so that the minimum adult size is probably about 3 mm. The body is elongated, the length being 4-5 times the breadth. The latter is comparatively uniform, but the tail is distinctly pointed. The anterior end is more rounded, while there is a tendency for a slight narrowing to occur about or behind the ventral sucker. In young specimens the body is flattened, but it becomes much thicker as the uterus increases in size. In transverse section an adult specimen presents a strongly convex dorsal surface and a flat or slightly convex ventral surface.

* From the Lister Institute of Preventive Medicine, London.

† For explanation of the Plates see p. 686.

The cuticle is fairly thick, somewhat deciduous, and is studded throughout its whole extent by stout salient spines. These are regularly arranged, and become sparse towards the posterior end. The underlying musculature has the usual formation.

In an average adult specimen of 6.5 mm. length the oral sucker has a diameter of .45 mm. It is subterminal, globular, and its aperture has a marked muscular rim. The thickness of its wall is about .13 mm. In the same specimen the ventral sucker measures .66 mm. It is also globular, slightly flattened, and its wall is .18 mm. thick. The sucker ratio is, therefore, very approximately 2:3. The diameter of the sucker relative to the body-length diminishes as the animal increases in size. Thus, in the smaller specimens the ventral sucker is $\frac{1}{7}$ of the body-length, while in the largest it is only $\frac{1}{11}$. The ventral sucker is situated about $\frac{1}{3}$ of the body-length from the anterior end. In this respect, again, the young specimens differ from the older ones in that they have the ventral sucker relatively further back.

There is a very short prepharynx; usually the pharynx is contiguous with the oral sucker, and it measures $.23 \times .17$ mm. The œsophagus is about $\frac{3}{4}$ of the length of the pharynx, although it is longer in young specimens. The intestinal bifurcation takes place well in front of the ventral sucker. The intestinal diverticula run almost parallel to the edges of the body. They bend in a little just behind the ventral sucker, but they are pressed out again by the testes. At their termination, just behind the posterior testis, they usually turn in a little. Their ends are about $\frac{2}{5}$ of the body-length from the posterior end. They are comparatively narrow tubes, and their wall is crinkled on the inner side. The outer side is plain. They are lined by a layer of low epithelium. The œsophagus has the usual cuticular lining. Throughout their whole extent the diverticula are somewhat ventral in position.

The excretory system is characteristic and agrees with Odhner's supposition as to its form in the group to which this species belongs. The vesicle consists of a fairly broad main stem, opening at the tip of the tail and passing forwards to the shell-gland, where it divides into two limbs. These diverge to form a Y, and each passes over the edge of the ventral sucker and terminates halfway between the sucker and the intestinal bifurcation. The main stem is pressed close to the dorsal surface, but the limbs are not quite so dorsal in position. They eventually come to lie close up to the intestinal diverticula and separate these from the uterus and cirrus-pouch respectively (Pl. XXVII. fig. 4). The main stem is much compressed dorso-ventrally, but the limbs are round or compressed transversely. In addition to this central system, however, numerous lateral twigs are given off from the stem and limbs. These all radiate outwards towards the edges of the body, dividing and subdividing and eventually forming an intricate anastomosis (Pl. XXVII. fig. 3). The entire lateral fields of the body are thus filled with a complex network of excretory tubes, and the amount

of parenchymatous tissue is very much reduced. This is more particularly the case in the post-acetabular region. It gives rise to a reticulated appearance, which is strikingly seen in young specimens (Pl. XXVII. fig. 1). In older specimens it is obscured by the growth of the uterus.

The genital glands are difficult to distinguish in the adult, but are easily seen in younger specimens. The testes lie not very far behind the ventral sucker, near and internal to the ends of the intestinal diverticula. They are obliquely situated, the left testis being half its diameter in advance of the right, and they are separated from each other by the uterus. In a young specimen, the uterus being narrow, they lie quite close together, but they are pressed further and further apart by the growth of the uterus. They are flat, elongated oval bodies measuring at least $.8 \times .4$ mm. Their outer margin is plain, but their inner margin is indented in one or more places, so that the outline is somewhat irregular. At first they lie almost flat in the body, but the expansion of the uterus pushes their inner border towards the dorsal surface so that eventually they are considerably tilted.

The genital aperture is situated on the left side midway between the pharynx and the edge of the body. It is always on the level of the pharynx. The cirrus-pouch is of considerable length, and is a conspicuous object. It is elongated, somewhat slender, and extends to the middle of the ventral sucker. Its wall is remarkable for the great development of the longitudinal muscular fibres, which are stout and very prominent. The circular fibres are much smaller. Within the pouch there is a more or less highly convoluted vesicula seminalis. Usually it is simply bent double (Pl. XXVII. fig. 2), but frequently it is much more twisted. It is small compared with the size of the cirrus-pouch. It is not much dilated, and it is connected with the pars prostatica by a narrow duct. The pars prostatica is of relatively great length. It is an almost straight tube extending from a little in front of the ventral sucker to the point where the cirrus-pouch crosses the left intestinal diverticulum. It is uniform and fairly narrow. Surrounding it are numerous prostatic cells which fill up the greater part of the cirrus-pouch. The ductus ejaculatorius is short and narrow, and the exsertile, unarmed cirrus is not very long. The genital sinus is quite small.

The ovary is situated just behind the end of the cirrus-pouch, over the right posterior quadrant of the ventral sucker. Half of it lies beyond the sucker, and it frequently overlaps the adjacent intestinal diverticulum. It is an almost globular body, somewhat flattened dorso-ventrally, and is about half the size of the testes. Behind and internal to it lies a compact shell-gland, with a short ootype and a Laurer's canal, but no receptaculum seminis. Laurer's canal is short and opens dorsally in the middle line, about the level of the ovary. A small yolk reservoir lies dorsal to the shell-gland. The yolk-glands are of limited extent. They are entirely lateral and lie close to the outer side of the intestinal diverticula. On each side there are about half a dozen ill-defined

groups of follicles, which extend from midway between the intestinal bifurcation and the anterior edge of the ventral sucker to near the ends of the intestines. The initial part of the uterus is practically empty. In section it can be made out with difficulty as an extremely narrow tube, passing backwards from the shell-gland. Behind the right testis it widens out to form a receptaculum seminis uterinum, consisting of about four or five small dilatations. Further back a few ova appear, but the uterus still remains somewhat narrow. When it has nearly reached the posterior end of the body it turns abruptly on itself to form an ascending limb. Almost immediately this begins to dilate, and it has only proceeded a short distance before it almost completely fills the interior of the body. It passes forward, over and between the testes, crosses the ventral sucker, and terminates in a straight, thick-walled vagina, which is about half the length of the cirrus-pouch, and lies on the left side. The uterus thus consists of a descending and an ascending limb, the former being empty for the greater part of its length, and the latter being enormously dilated. The increase in size, therefore, takes place, not by an increase in convolutions, but by a great dilatation of the ascending limb. The ova are very numerous, rounded oblong in shape, and dark brown in colour. They have a large well-marked operculum. Many of them are more oval than oblong, and this gives rise to some variation in dimensions. From a large number of measurements the limits were found to be $\cdot038$ – $\cdot045$ mm. for the length, and $\cdot018$ – $\cdot023$ mm. for the breadth, and the average $\cdot040 \times \cdot021$ mm. The extreme sizes observed were $\cdot045 \times \cdot018$ mm. for the most oblong ova, and $\cdot038 \times \cdot023$ mm. for the most oval.

No case of amphitopy was observed in any of the two dozen specimens forming the collection. The nearest approach was in one specimen where the testes were practically symmetrical, the left being a trifle behind the right, but the ovary and genital aperture were normal. In all the other specimens the position of these structures was exactly as I have described. The species, however, is extremely variable in one respect, namely, the posterior limit of the yolk-glands. Hardly two specimens agree in this respect. In some specimens they extend a short distance beyond the testes, in others they reach the middle of the posterior testis, and again in others they stop short of the testes. In addition, they are very frequently asymmetrical, extending further back on the right than on the left, or more rarely *vice versa*. The fact, however, that their anterior limit is constantly symmetrical induced me to consider a symmetrical posterior limit as the normal. In two specimens also, the intestinal diverticula were of unequal length, the left diverticulum being considerably shorter than the right, which was normal. The position of the genital aperture varied only very slightly, and most of the apparent variations were due to contraction. The length of the cirrus-pouch was practically constant, although in one specimen it extended nearly to the posterior border of the ventral sucker. The size of the ova was constant within the limits noted, and no increase in size takes

place as the animal grows older. The average size of the ova in young specimens was found to be the same as that in fully grown specimens, and I am inclined to view with some doubt Ödhner's statement (2. p. 59) that the ova in *Renifer sauromates* Poir. increase in size as the animal grows older.

From *Lechriorchis elongatus* Pratt, this species is distinguished by having more unequal suckers, the ventral being decidedly larger, the yolk-glands being more extensive, being present some distance in front of the ventral sucker, and in having slightly larger eggs. From *L. primus* Staff., it appears to be distinguished by its much smaller eggs, its smaller ventral sucker, and probably in other respects.

The second lot of specimens consists of five from an Annulated Snake (*Leptodira annulata*). They bear a close superficial resemblance to *Lechriorchis validus*, but they do not belong to the same genus. The only genus to which they can at present be referred is *Ochetosoma* Braun, 1902, but they do not entirely agree with the definition of that genus as given by Braun. In internal anatomy they correspond quite closely, but they are not nearly so flattened as *O. monstrosus* Brn., the only species of the genus. The only other genus to which they could be referred is *Renifer* Pratt, 1903, but from that they differ radically in the configuration of the uterus.

OCHETOSOMA FORMOSUM, sp. n. (Plate XXVIII. figs. 6 & 7.)

The body is elongated and slightly flattened. The length is 3.7–5.7 mm., and the greatest breadth, about the ventral sucker, is 1.1–1.6 mm. The breadth is therefore rather less than $\frac{1}{3}$ of the length. The body tapers gradually towards each end.

In an average specimen (length 4.5 mm.) the oral sucker has a diameter of .45 mm., i. e. $\frac{1}{10}$ of the body-length. It is globular and subterminal. The ventral sucker is situated 1.7 mm. from the anterior end. It is slightly oval, the transverse diameter being .64 mm., and the longitudinal .57 mm. The sucker ratio is therefore approximately 3:4.

The cuticle is extremely deciduous; in most of the specimens it was almost entirely stripped off. Only in one was it intact, and even then not completely so; from this specimen the presence of minute regular spines was determined.

There is a short prepharynx followed by an almost globular pharynx, measuring .17 × .16 mm. The oesophagus is about the same length as the pharynx (.2 mm.), and the intestinal bifurcation occurs well in front of the ventral sucker. The diverticula diverge pretty widely, and they terminate almost immediately behind the ventral sucker, the ends being somewhat turned in. They are narrow and irregularly dilated, but there is no crenation on their inner wall as in *Lechriorchis validus*. They are lined by low epithelium.

The excretory system is almost identical with that in *Lechriorchis validus*. The vesicle consists of a similar dorsal main stem, which

divides just behind the ovary into two limbs, which pass forwards a short distance in front of the ventral sucker. They are thus not so long as in the above mentioned species. The main stem, too, appears more expanded. There is the same system of secondary lateral branches which anastomose freely in the sides of the body.

The genital aperture is situated almost at the extreme left margin of the body, on the level of the posterior end of the pharynx. The genital sinus is very small. The cirrus-pouch is very like that of *Lechriorchis validus*, but it is shorter. It is usually disposed obliquely, and it terminates a short distance in front of the ventral sucker, from which its end is usually separated by a coil of the uterus. In one specimen it almost reached the sucker. It contains a small convoluted vesicula seminalis, ending in a narrow portion which runs into the pars prostatica. The latter is not so long as in the foregoing species, and it is more expanded, especially at its posterior end. The prostatic cells are numerous. There is a short ductus ejaculatorius, and an unarmed cirrus of moderate length. The testes are situated just behind the middle of the body (.3 mm. behind the ventral sucker). They are symmetrical and lateral. They lie behind the ends of the intestines, but are separated from them by folds of the uterus. The length of each is about .5 mm. They are fairly thick and elongated, and their outer margin is always distinctly divided into three large lobes, which may in addition be slightly crenated. The inner margins are completely obscured by the overlying folds of the uterus.

The ovary is situated over the right posterior quadrant of the ventral sucker and projects half beyond it. It is obliquely ovoid and measures .24 x .17 mm. A large shell-gland lies close to its inner side. The yolk-glands are entirely lateral and of limited extent. They reach from the anterior border of the ventral sucker to about the middle of the testes. Again in this species, however, the posterior limit is extremely variable, and may be anywhere between the anterior and posterior borders of the testes, but never beyond them. The anterior limit is practically constant. The uterus fills almost the whole of the post-acetabular region, but its configuration is entirely different from that in *Lechriorchis*. Here, again, the descending limb is small and almost empty; reaching the posterior end of the body it turns into the ascending limb. In this case, however, accommodation for the enormous number of ova is obtained not by excessive dilatation, but by numerous convolutions, the diameter of the uterus not being very greatly increased. The convolutions have a markedly transverse disposition, extending from side to side of the body. In the region of the testes the convolutions are shorter and stouter. An additional small convolution is formed in front of the ventral sucker. The uterus terminates in a well-marked vagina, which is about a third of the length of the cirrus-pouch. The ova are very like those of *Lechriorchis validus*, but are usually more oval. They have a large distinctly-marked operculum, and

they vary in length from .034 mm. to .042 mm. by .017 mm. to .021 mm. in breadth. The average is about 4×2 mm.

In this species, again, no case of amphitypy was observed, and the only pronounced variation was in respect of the posterior limit of the yolk-glands as described above.

The species obviously presents a close resemblance to the genus *Renifer* Pratt, *sens. strict.* In the shortness of the intestinal diverticula, the symmetrical situation of the testes, and the extreme lateral position of the genital aperture, the agreement is complete. The essential difference lies in the configuration of the uterus. *Renifer ellipticus* Pratt, the type species, is unfortunately not fully grown and the ultimate disposition is not apparent. In *R. sawomates* Poirier, the uterus is of the same type as in *Lechriorchis validus*, and if this be taken as characteristic of the genus, then *O. formosum* must be separated from that genus.

It is evident that the three genera *Renifer*, *Lechriorchis*, and *Ochetosoma* are somewhat closely related, and they differ from all the other members of the family Lepodermatidae in the extreme lateral and forward position of the genital aperture. They evidently form the nucleus of a group, but the extremely profuse variety met with in the family renders it somewhat difficult to divide it into definite subfamilies. Provisionally, however, these three genera may be classified under Pratt's subfamily Reniferinae. That *Pneumatophilus* Odhn., and *Leptophallus* Lühe, are to be included along with these, as Odhner has indicated (2. p. 56), appears to me somewhat doubtful.

The third form which I have to describe here is one of very great interest. It was obtained from a Diamond Water-snake (*Tropidonotus rhombifer*) from North America. The habitat, unfortunately, is not recorded. It bears a certain resemblance to the foregoing species, and belongs to the family Lepodermatidae, but it possesses an individuality sufficiently marked to constitute a distinct generic type.

DASYMETRA CONFERTA, gen. et sp. n. (Plate XXVIII. figs. 8-10.)

The collection consisted of about a dozen specimens, all of which were mature, and measured 3.5-4.6 mm. in length. The body is elongated, slightly flattened and of fairly uniform breadth. The greatest breadth occurs about the middle and is 1-1.4 mm. The length is therefore about $3\frac{1}{2}$ times the breadth. The cuticle is beset throughout its whole extent by long straight spines. It appears to be somewhat deciduous, and in many specimens is absent from a considerable part of the body, especially towards the posterior end. Several specimens, however, retained the cuticle and spines quite intact.

In a specimen of average length (4.2 mm.) the oral sucker measures .56 mm. in diameter. It is globular, almost terminal and not very muscular. The ventral sucker is practically of equal size, if anything a trifle less. It is somewhat transversely oval, the dimensions being $.52 \times .57$ mm. It is only slightly prominent,

not very muscular, and is situated 1.7 mm. from the anterior end. The neck, therefore, comprises $\frac{2}{5}$ of the body-length.

The alimentary canal is highly developed. It consists of a very short prepharynx, with an enormous pharynx measuring .28 mm. in diameter. The œsophagus is shorter than the pharynx, being only about .2 mm. long. It is fairly wide, with well-developed musculature and numerous peri-œsophageal cells. It divides into two very wide diverticula, which extend along the sides of the body to near the posterior end. From the latter they are separated by a loop of the uterus. The ends are slightly inflated and somewhat turned in.

The excretory system has the same general structure as in the two previous species. The main stem of the excretory vesicle divides close behind the shell-gland into two limbs, which extend a short distance in front of the ventral sucker. From the vesicle numerous twigs are given off, which divide and subdivide in the lateral fields to form an intricate anastomosis. The most peculiar feature of the excretory system, however, is the pigmented condition of the excretory tubules, which renders them strikingly conspicuous and marks out their course with great distinctness. This feature renders the species unique amongst the *Lepodermatidæ*. The pigmentation is due to the excretory granules, which are almost black in colour, and which fill the tubules. Only a few of these are to be met with in the vesicle. A main excretory tubule runs along the greater part of the length on each side of the body, ventral to the intestinal diverticula. In front of the ventral sucker it divides into small branches, one of which runs in to join the vesicle, and another runs forward to the oral sucker. At the posterior end it also divides into several branches. It is impossible to say whether this pigmented condition occurs in life or is a post-mortem appearance, but it was certainly present in all the specimens.

The genital aperture is median, just over the intestinal bifurcation (.3 mm. in front of the ventral sucker). It shows a tendency to be deflected very slightly to the left side. In every specimen the long, thick cirrus was exerted. The cirrus-pouch is short and stout, in some cases being almost globular. Its posterior end lies dorsal to the middle of the ventral sucker, but it may extend beyond this to almost the posterior border of the sucker. The pouch has an external wall composed of very thick longitudinal muscle-fibres, with an inner layer of much smaller circular fibres. It contains a small, slightly-coiled vesicula seminalis, a small bulbous pars prostatica, with numerous prostatic cells, and a long ductus and unarmed cirrus. As already mentioned, the latter was exerted in every case, so that the arrangement depicted in fig. 8 (Pl. XXVIII.) must be regarded as hypothetical. The vesicula, prostate, and cirrus all have a very well-marked layer of longitudinal muscle-fibres.

The testes are situated obliquely, the left being well in front of the right, but not entirely so. The former lies about .3 mm., and the latter .8 mm. behind the ventral sucker. They are large ovoid

bodies, with entire margins, and their long axes lie nearly in the longitudinal axis of the body. They measure $\cdot 5$ – $\cdot 7$ mm. in length and $\cdot 4$ – $\cdot 5$ mm. in breadth. They are most remarkable, however, for their great thickness, which is equal to or greater than the breadth. They thus occupy nearly the whole body-thickness, a fact which prevents them being obscured by the uterus. They are separated from each other by the wide ascending limb of the uterus, against which they press, and their outer margins are closely apposed to the intestinal diverticula.

The ovary is situated over the right posterior quadrant of the ventral sucker, a short distance behind the end of the cirrus-pouch. It projects well beyond the sucker, and is transversely oval, measuring $\cdot 35$ mm. $\times$ $\cdot 28$ mm. It lies close up to the dorsal surface of the body. Close to the inner side of the ovary and a little behind it, lies a large shell-gland, with a short ootype. A receptaculum seminis is absent, but Laurer's canal is present. The yolk-glands are rather voluminous. They are entirely lateral and peripheral, and they extend from the level of the genital aperture, or rather behind it, to near the posterior border of the right testis. Here, again, the anterior limit is fairly constant, but the posterior limit is somewhat variable, less so, however, than in the two species already described. The follicles are large and arranged in regular dendritic groups. All the follicles are connected up by short ducts. They lie close under the surface of the body, extending widely under the dorsal surface, but being much more restricted ventrally, where they do not overlap the inner wall of the intestinal diverticula.

The uterus is large and voluminous, but is not much convoluted. It is intermediate in type between that of *Renifer* and *Ochetosoma*, but resembling the former more than the latter. It consists of a small descending limb, which has a dorsal position and contains a considerable number of ova. This runs to the posterior end of the body where it forms a small convoluted knot, a fairly symmetrical pair of loops, one on each side, being thrown up towards the ends of the intestinal diverticula. From this knot emerges the ascending limb, which rapidly widens but does not attain its maximum width till it has passed in front of the testes. It is never so enormously dilated as in *Lechriorchis validus*. Near the middle of the ventral sucker it runs into a remarkably powerful vagina, which is as long as or somewhat longer than the cirrus-pouch. The vagina possesses unusually muscular walls, there being a very thick layer of longitudinal fibres and an equally thick layer of circular fibres. It is surrounded by a great mass of peri-vaginal cells, and it is lined by a thick layer of cuticle from which small regular cuticular processes extend into the lumen. The ova are numerous, dark brown and oval, with large well-marked operculum. They measure $\cdot 033$ – $\cdot 037$ mm. in length and $\cdot 016$ – $\cdot 019$ mm. in breadth, the usual size being $\cdot 036 \times \cdot 018$ mm.

The genus *Dasymetra* may be defined as follows:—

Lepodermatidæ; with moderately flattened body, entirely covered

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with spines. Intestine with large pharynx and wide diverticula which extend near but not quite to the posterior end. Excretory vesicle Y-shaped with numerous side twigs. Genital aperture median, a short distance in front of the ventral sucker. Cirrus-pouch short and plump; vesicula and pars prostatica short; cirrus long. Receptaculum seminis absent; Laurer's canal present. Yolk-glands extensive, dendritic, peripheral. Uterus forming a small convoluted knot at the posterior end of the body, with a wide unconvoluted ascending limb. Vagina long and very muscular. Ova about .035 mm. long.

Type, *D. conferta*, sp. n.

The type-specimens of these species are deposited in the Museum of the Royal College of Surgeons, London. Co-types at the Zoological Society's Gardens.

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EXPLANATION OF THE PLATES.

The following letters apply to all the figures:—

<i>D.St.</i> Yolk-glands.	<i>R.S.Ut.</i> Receptaculum seminis
<i>Ex.</i> Excretory vesicle.	uterinum.
<i>Ex.T.</i> Excretory tubules.	<i>T., T₁, T₂.</i> Testes.
<i>J.</i> Intestinal diverticula.	<i>Ut.</i> Uterus.
<i>K.St.</i> Ovary.	<i>Vg.</i> Vagina.
<i>P.Pr.</i> Pars prostatica.	<i>V.S.</i> Vesicula seminalis.

PLATE XXVII.

Lechriorchis validus.

- Fig. 1. Young specimen. Ventral view. × 25.
2. Adult specimen. Ventral view. × 20.
3. Transverse section near ends of intestinal diverticula. × 53.
4. Transverse section, immediately in front of ventral sucker. × 50.
5. Ovum. × 500.

PLATE XXVIII.

Ochetosoma formosum.

- Fig. 6. Ventral view. × 30.
7. Ovum. × 550.

Dasymetra conferta.

- Fig. 8. Ventral view. × 30.
9. Transverse section, a little in front of ventral sucker. × 60.
10. Ovum. × 500.